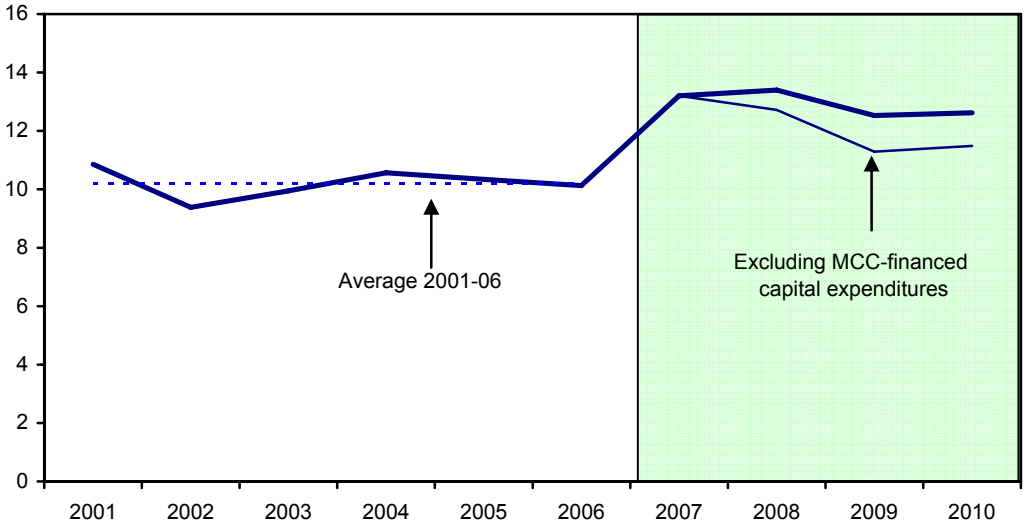
Tables

I. Public Investment and Growth in Burkina Faso[1]

A. Introduction

1. This paper assesses the link between public investment and economic growth in Burkina Faso, where the authorities plan to significantly increase public investment in the medium term. In 2007–10, the public investment-to-GDP ratio is expected to increase by about 2 percentage points from its 2000–06 average (Figure I.1). The paper first explores the role of public investment in growth using a standard neoclassical growth model. It then reviews the empirical evidence of the growth effect of public investment and provides an assessment of the likely growth impact for Burkina Faso.

Figure I.1: Burkina Faso: Capital Expenditures and Net Lending, 2001–10
(Percent of GDP)



Sources: Burkinabè authorities; and IMF staff estimates.

2. The theoretical analysis shows that the role of public investment in growth depends on the nature of the growth process. In a neoclassical framework, there are essentially two types of growth: (i) steady-state growth, where the economy is in steady state and growth occurs as productivity shocks shift the steady state outward; and (ii) growth through a convergence process, whereby the economy starts at a low base and converges toward a given higher-income steady state. Determining which of these growth processes applies more to a low-income country like Burkina Faso matters greatly, because in the former the impact of investment on growth is likely to be limited whereas in the latter it could have large

[1] Prepared by Jan Gottschalk.

effects. The paper argues that the steady-state growth process is probably more relevant for Burkina Faso.

3. The theoretical analysis is complemented by a review of empirical evidence on the effect of public investment on growth. While there is considerable uncertainty, overall the empirical evidence points to a modest impact of public investment on growth; an increase in the public investment-to-GDP ratio by 1 percentage point appears to raise output growth by about 0.2 percentage points. Applying this to the proposed increase in Burkina Faso's public investment ratio would suggest a growth impact of about 0.4 percentage points for as long as the higher investment rate is maintained. This would be a noticeable contribution, but far from a dominant influence on Burkina Faso's growth performance.

B. A Neoclassical Model with Public Investment[2]

4. The model used here is a standard neoclassical model with an endogenous savings decision. Consumers maximize utility,

(1) $$\sum_{t=0}^{\infty} \beta^t U(c_t),$$

where β is a discount factor and c_t consumption; the utility function is given by $U(c_t) = \frac{c_t^{1+\gamma}}{1+\gamma}$.[3] Consumers also hold capital, produce, and pay taxes. The government uses the tax revenue to create public capital, which enters into the private sector production function:

(2a) $$F(K_t, L_t, A_t, Q_t) = \left(K_t^{\alpha}\left(A_t L_t\right)^{1-\alpha}\right)^{\theta} Q_t^{1-\theta},$$

where K_t is capital, L_t is labor, A_t is productivity, and Q_t is public capital. Both labor and productivity are assumed to grow at constant rates g_1 and g_2; expressing other variables in efficiency labor terms (i.e., rescaling them by $A_t L_t$[4]) to ensure that they are constant in steady state, yields for the production function:

(2b) $$f(k_t, q_t) = k_t^{\alpha\theta} q_t^{1-\theta}.$$

5. The government is assumed to tax aggregate output at a constant rate τ, so that government revenue and investment is given by $\tau f(k_t, q_t)$. Assuming depreciation rates of δ_1 for private capital and δ_2 for public capital, capital accumulation equations are given by:[5]

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[2] This model has been developed by Tokhir Mirzoev.

[3] The parameter γ represents the (inverse) of the intertemporal elasticity of substitution in consumption.

[4] For example, private capital in efficiency labor terms is defined as $k_t = \frac{K_t}{A_t L_t}$. Efficiency labor terms are denoted by small letters.

[5] Equations (3) to (5) are all expressed in efficiency labor terms.

(3) $$k_{t+1} = \frac{(1-\delta_1)k_t + (1-\tau)f(k_t, q_t) - c_t}{(1+g_1)(1+g_2)}$$, and

(4) $$q_{t+1} = \frac{(1-\delta_2)q_t + \tau f(k_t, q_t)}{(1+g_1)(1+g_2)}$$.

The Euler equation, derived from utility maximization subject to the above budget constraints, is:

(5) $$c_t^{\gamma} = \frac{\beta c_{t+1}^{\gamma}}{(1+g_2)^{\gamma}}\left((1-\delta_1) + (1-\tau)f'(k_{t+1})\right).$$

6. Equations (2b) to (5) are sufficient to simulate the model, after choosing appropriate parameter values. The simulations below are based on the following choices: $\alpha = 0.35$, $\beta = 0.98$, $\delta_1 = \delta_2 = 0.05$, $\gamma = -0.9$, $\theta = 0.8$, $g_1 = 0.02$, $g_1 = 0.01$, and $\tau = 0.08$. Most of these values are standard parameters in the literature; the parameters for population growth, productivity growth, and the tax rate have been broadly aligned with values for Burkina Faso.[6]

C. Steady-State Growth

Growth through productivity shocks—a baseline scenario

7. In neoclassical growth theory, the steady-state growth rate of the economy is typically determined by the underlying growth of labor force and productivity.[7] If one considers per-capita income as a proxy of development, productivity becomes the key factor in determining growth. While the neoclassical model introduced above incorporates a constant growth rate for productivity, it is useful to consider a one-time, permanent, upward shift in productivity—resulting, for example, from the introduction of a new technology—to illustrate the underlying transmission mechanism of the model, as well as to introduce a baseline scenario with ”typical” growth from a neoclassical viewpoint. To this end, the production function in the model is modified to include a stochastic productivity shock, ε_t:

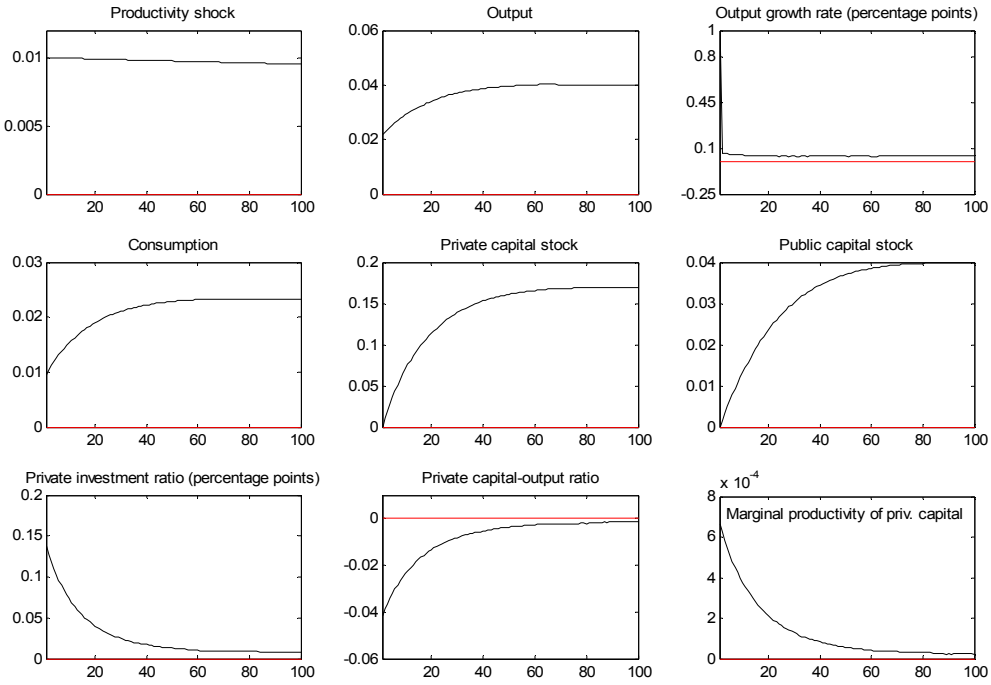
(2c) $$f(k_t, q_t) = k_t^{\alpha\theta} q_t^{1-\theta} \varepsilon_t .$$

[6] Given that all tax revenue in this model is used for investment, the tax rate has been set equal to the share of government investment in GDP over past years, using the national accounts definition of government investment.

[7] In the model outlined above, the steady state growth rate is given by the sum of g_1 and g_2, representing labor force and productivity growth respectively. The fact that both growth rates are exogenous—i.e., they are determined outside the neoclassical growth model—implies that the model's steady state growth rate is exogenous as well; consequently, the model's main analytical contribution is not an explanation of the steady state growth rate, but the economic adjustment processes that occur if the economy is outside its steady state, as shown in the model simulations above. While a large strand of literature has been developed to endogenize the steady state growth rate, a review of the endogenous growth literature is outside the scope of this paper.

8. Figure I.2 displays the model's response to a positive productivity shock using impulse-response functions, which depict the deviation of variables from their baseline (i.e., steady-state value) in response to the shock.[8] The shock is permanent, i.e., an innovation x occurring at t_1 would raise productivity in all future years: $\varepsilon_{1+j} = \varepsilon_0 + x$, for $j = 0,1,2,...\infty$.[9]

Figure I.2. Response to Productivity Shock
(Deviation from baseline)



Source: IMF staff estimates

9. The increase in productivity owing to the productivity shock directly raises output; moreover, it raises the marginal productivity of capital, which induces higher private investment and a buildup of the private capital stock, leading to further output gains over time. Higher output also raises tax revenues, which leads public capital to build up at the same time. Once the economy has reached its new steady state—consistent with its permanently higher productivity level—output, consumption, and capital stocks have converged at new, higher levels; meanwhile, the marginal productivity of private capital, the

[8] Note that the baseline deviations cannot be interpreted as deviations in percent, unless otherwise indicated, because the model variables are not expressed in logarithms; the absolute deviations have no meaningful economic interpretation. Thus, the focus should be on the qualitative response.

[9] In the actual simulations, the shock is highly persistent but not permanent because of computational problems.

private investment-to-GDP ratio, and the private capital-to-output ratio return to their original steady state.

10. The growth process through productivity shocks has two defining characteristics:

- Individual shocks raise the output level, but have no long-run effect on economic growth. Consequently, sustained output growth requires continuous innovations that raise productivity—i.e., a stream of productivity shocks. Given the nature of technical progress, though, it is plausible to assume that there is an infinite supply of productivity shocks. This distinguishes it from other sources of growth that are inherently finite in supply (e.g., public or private investment).
- Growth through productivity shocks represents growth through shifts in the steady state. That is, the economy is initially in steady state, but once a productivity shock occurs, the steady state of the economy is shifted outwards—i.e., the economy can sustain a higher output level in steady state—and the economy converges to its new steady state, growing in the process.

Growth through private sector capital deepening

11. Given that public investment leads to a crowding-in of private investment, it is useful to consider first the role of private capital accumulation for growth. Private investment is endogenous in the neoclassical model outlined above, with the investment/savings decision determined by intertemporal utility maximization. Nevertheless, there are essentially two ways to simulate an exogenous increase in private investment:

- First, an exogenous shock, ω_t, could be added to the equation for private capital accumulation (3) in order to simulate an exogenous increase in the capital stock:

$$(3a) \qquad k_{t+1} = \frac{(1-\delta_1)k_t + (1-\tau) f(k_t, q_t) - c_t + \omega_t}{(1+g_1)(1+g_2)}.$$

  This shock would simulate an increase in the capital stock outside the budget constraint of the model, i.e., it would correspond to an exogenous capital transfer. However, it is not clear to what real-world scenario this shock would correspond. In any event, simulations show that a large part of such a transfer would be offset by a reduction in other private investment (i.e., economic agents would use the "free" addition to their capital stock to reduce their own investment effort). Given that the economy was initially in steady state and the original private capital stock optimal, using the freed-up resources for increasing consumption appears sensible.[10] Consequently, in this scenario the effect on output (and growth) is small.
- Second, one could simulate an increase in investment through higher savings by exogenously increasing the private capital stock, as above, while simultaneously

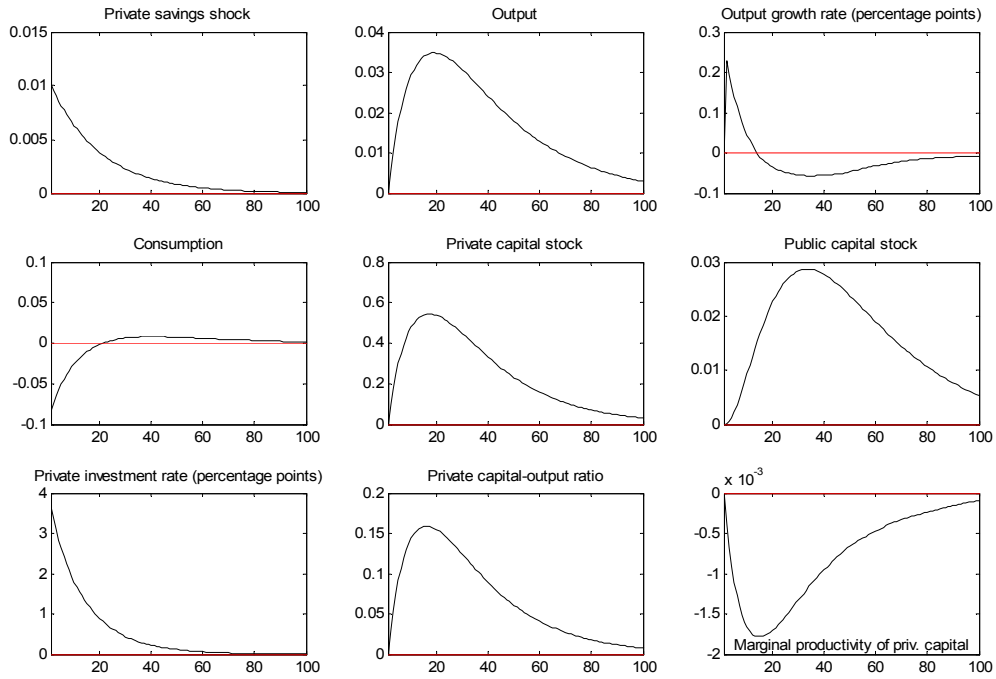
[10] Results available upon request.

decreasing consumption by the same amount. That is, equation (3) would be substituted with (3a), and the Euler equation (5) would become:

(5a) $$(c_t + \omega_t)^{\gamma} = \frac{\beta c_{t+1}^{\gamma}}{(1+g_2)^{\gamma}}\left((1-\delta_1)+(1-\tau)f'(k_{t+1})\right)$$

12. The results for a fairly persistent private savings shock are shown in Figure I.3. By design, the private savings shock increases the private investment-to-GDP ratio at the expense of lower consumption; the resulting buildup of the private capital stock leads to higher output, and, through the increase in tax revenue, to a higher public capital stock. This process is characterized by capital deepening (i.e. the private capital-output ratio increases), whereas the marginal productivity of capital declines. In the long run, when the private savings shock dissipates, all variables return to their previous steady state.

Figure I.3. Response to Private Savings Shock
(Deviation from baseline)



Source: IMF staff estimates.

13. Relying on capital deepening for growth is likely to be problematic for a number of reasons:

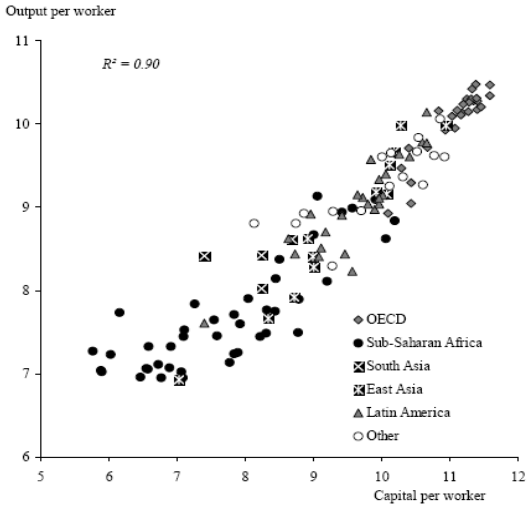
- First, the simulations show that a permanent increase in the investment (and savings) rate-to-GDP would permanently raise the output level, but have only a temporary impact on the growth rate; a permanent increase in growth through capital deepening

would require continuous increases in the investment-to-GDP ratio, which is infeasible.[11]

- Second, if the economy starts out from steady state, raising the savings rate is unlikely to be optimal, because though output increases, it comes at the expense of lower consumption, at least initially, and distorts the savings/investment decision of economic agents.[12]

- Third, there is little evidence that real-world economies grow through capital deepening, which would imply that capital-output ratios are much higher in developed than developing economies. Figure I.4 compares output per working-age person and capital per working-age person across 127 countries; labor productivity and capital intensity are clearly strongly correlated, but the capital-output ratio—which is given by the inverse of the slope of an imaginary regression line through the observed data points—appears to be relatively constant over different development stages.[13] This is consistent with growth through productivity shocks, where the capital-output ratio returns to its original baseline value, but not with growth through capital deepening. Moreover, a detailed growth-accounting analysis by Young (1995) for fast-growing Asian economies shows that physical capital accumulation accounted for only a small part of their growth performance.

Figure I.4. Capital-Output Ratios Over Different Development Stages



Note: Output per worker and capital per worker in logs; 127 countries, ca. 1990; "OECD" excludes Mexico, South Korea, and Turkey, "Other" includes North Africa, Middle East, and former socialist countries.

Source: Reproduced from Gundlach (2006).

[11] In fact, the decline in the marginal productivity of private capital—which reflects the diminishing returns characteristic of neoclassical models—implies that for maintaining a given growth rate, ever-larger increases in the investment-to-GDP ratio would be needed.

[12] Raising the savings rate may be optimal if this overcomes distortions that keeps the savings rate suboptimal low; such mechanisms can be present in poverty-trap models, but a recent review by Kraay and Raddatz (2005) finds little evidence that these distortions are empirically relevant.

[13] This analysis, and the chart, have been reproduced from Gundlach (2006).

Growth through grant-financed public investment

14. An increase in public investment can be simulated in the model considered here either through an exogenous increase in the public capital stock or through raising the tax rate. Beginning with the former, a stochastic public capital shock is added to the equation for public capital accumulation, (4), which becomes:

(4a) $$q_{t+1} = \frac{(1-\delta_2)q_t + \tau f(k_t, q_t) + \upsilon_t}{(1+g_1)(1+g_2)}.$$

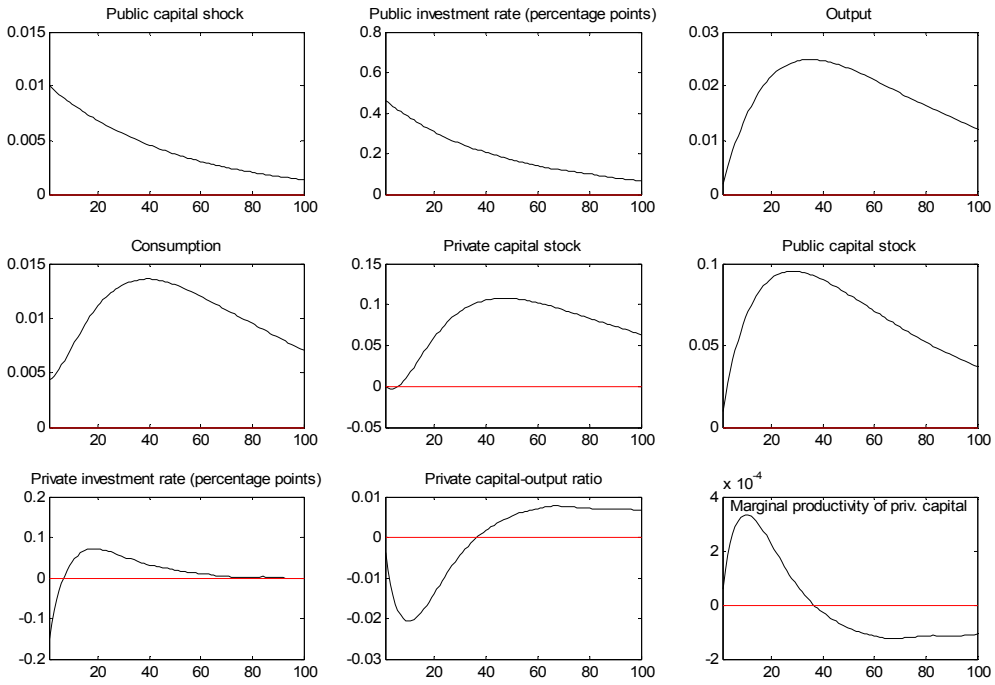
15. This shock increases the public capital stock outside the model's budget constraint, i.e., without recourse to tax financing, which could correspond to public investment financed through external project grants.

16. The simulation results in Figure I.5 show that an increase in public capital raises both output and the marginal productivity of private capital on impact, which—after a short delay—leads to crowding in of private investment.[14] Private capital accumulation induces further output gains over time; public capital accumulation is supported by gains in tax revenue owing to output gains.

17. These simulations show that externally-financed capital accumulation is clearly beneficial to the economy in this model; if project grant inflows were to raise the public investment-to-GDP ratio permanently, both output and consumption levels would rise permanently as well. However, relying on project grants for a growth strategy would probably be unworkable, because, as in the case of private sector capital deepening, it would require the public investment ratio to continuously increase to generate a permanent increase in the growth rate; the necessary ever-larger grant inflows are unlikely to materialize. Moreover, once aid inflows are phased out, output gains would be lost and the economy would return to its original baseline.

[14] Consumption also increases on impact; initially, the increase in public capital substitutes to some extent for private capital accumulation, and the resulting decrease in private investment facilitates the increase in consumption. Over the medium term, though, private investment increases to take advantage of the rise in the marginal productivity of private capital.

Figure I.5: Response to Public Capital Shock
(Deviation from baseline)



Source: IMF staff estimates.

18. These results can be attributed to two defining characteristics of the model used here:

- The fact that output returns to its baseline after aid is phased out reflects the assumption that the economy is initially in steady state: the steady-state public capital stock is already optimal, and the economy will return to this level once the external stimulus disappears. The stimulus is still beneficial, but mostly because it enables temporarily higher consumption than would otherwise have been possible.
- The fact that a permanent increase in public investment raises the output level, but has no permanent effect on growth is due to the assumption of diminishing returns to capital accumulation inherent in neoclassical models. In contrast, in an endogenous growth-type model without diminishing returns, an increase in the public investment ratio could lead to a permanent increase in the growth rate.[15] In both models, public investment leads to a virtuous circle, where higher public investment leads to higher private capital accumulation, higher output, and higher tax revenue, further supporting public investment. In a neoclassical model with diminishing returns, the

[15] See Glomm and Ravikumar (1997).

effects of additional public investment become smaller with each round, until the economy settles in a new equilibrium with higher output levels.

- In the absence of diminishing returns, the effects of public investment do not fade out as the public capital stock becomes larger, and the virtuous circle is self-sustaining over time. Thus, the output effects of public investment always remain the same, regardless of how many cycles have passed. While a model without diminishing returns predicts a much more powerful effect of public investment on growth, it requires a specific parameter constellation to hold—the neoclassical model is much more robust in this regard—and empirical evidence does not point to particularly strong effects of public investment on growth, as shown below.

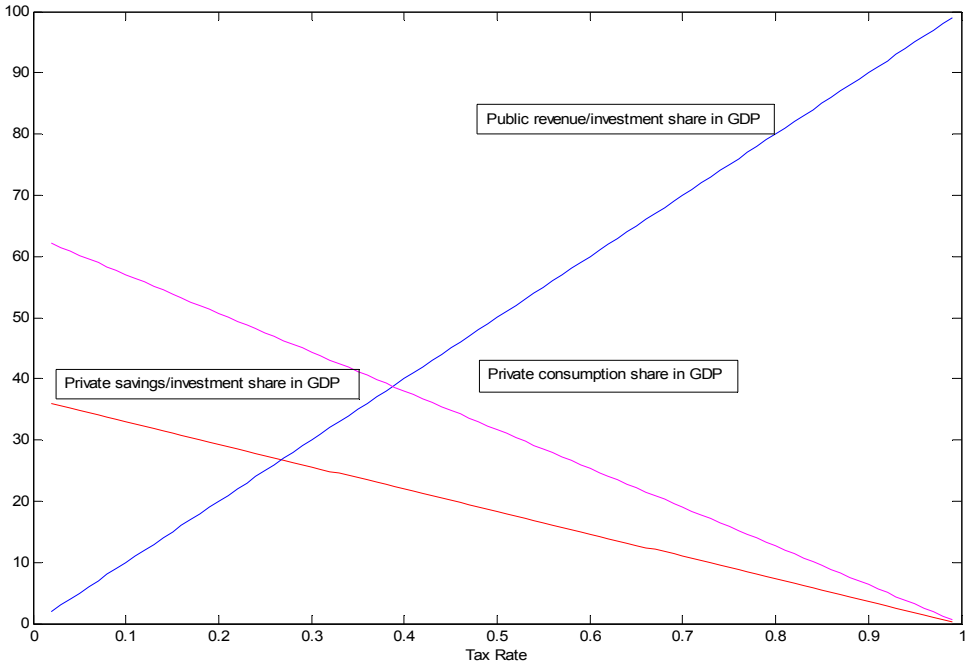
Growth through tax-financed public investment

19. Given that in the model all tax revenue is used to finance public investment, the tax rate and the public investment-to-GDP ratio are identical. Consequently, increasing the tax rate increases also the public investment-to-GDP ratio. Unlike grant-financed public investment, however, tax financing crowds out private investment and consumption (Figure I.6). The result is a Laffer-curve type relationship between tax rates on the one hand and output, disposable income, and tax revenue on the other (Figure I.7):[16]

- At tax rates below 20 percent in the model, the benefits of higher tax rates in the form of higher public investment—i.e., higher output and private capital accumulation—outweigh the disadvantage of transferring purchasing power to the government.
- At higher tax rates—between 20 and 40 percent in the model—an increase in the tax rate raises output through additional public capital accumulation, but the output gain is smaller than the increase in the tax burden, and disposable income, together with consumption and private investment, declines.
- At tax rates above 40 percent, the crowding out of private investment through higher taxes outweigh the benefits of additional public investment, and output declines. Tax revenue, though, continues to increase.
- At tax rates above 70 percent, the disincentive effects of higher taxation are so large that even tax revenue begins to decline.

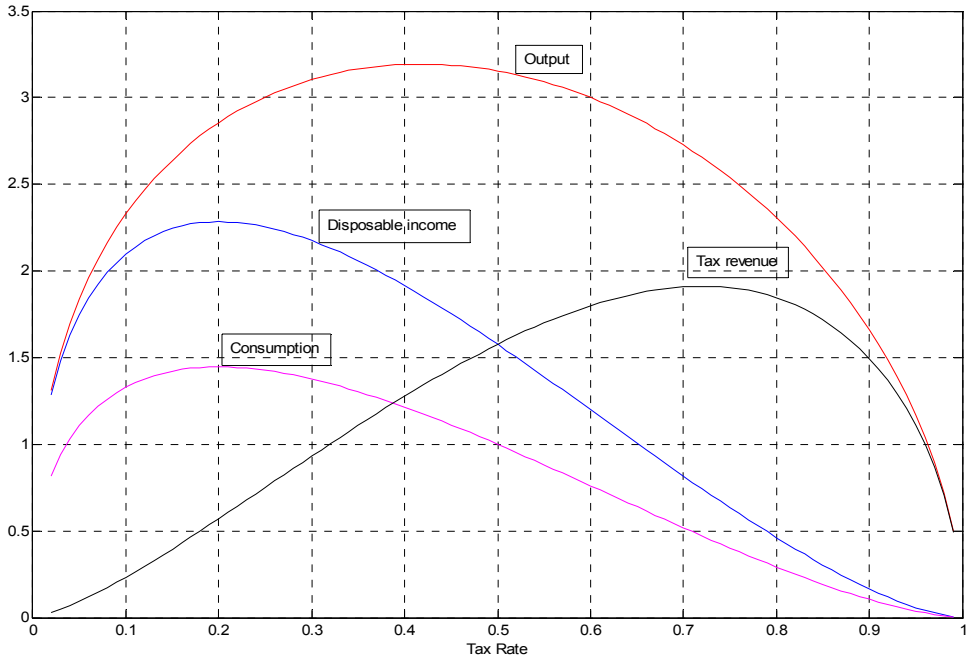
[16] The location of the Laffer curves depends on the parameter choices for the model. The simulations here are meant to illustrate the general economic principles, and not to identify the numerical values for tax rates that maximize disposable income, output, or tax revenue.

Figure I.6. Savings and Investment Shares in GDP as Function of Tax Rate



Source: IMF staff estimates.

Figure I.7. Selected Steady-State Variables as Function of Tax Rate

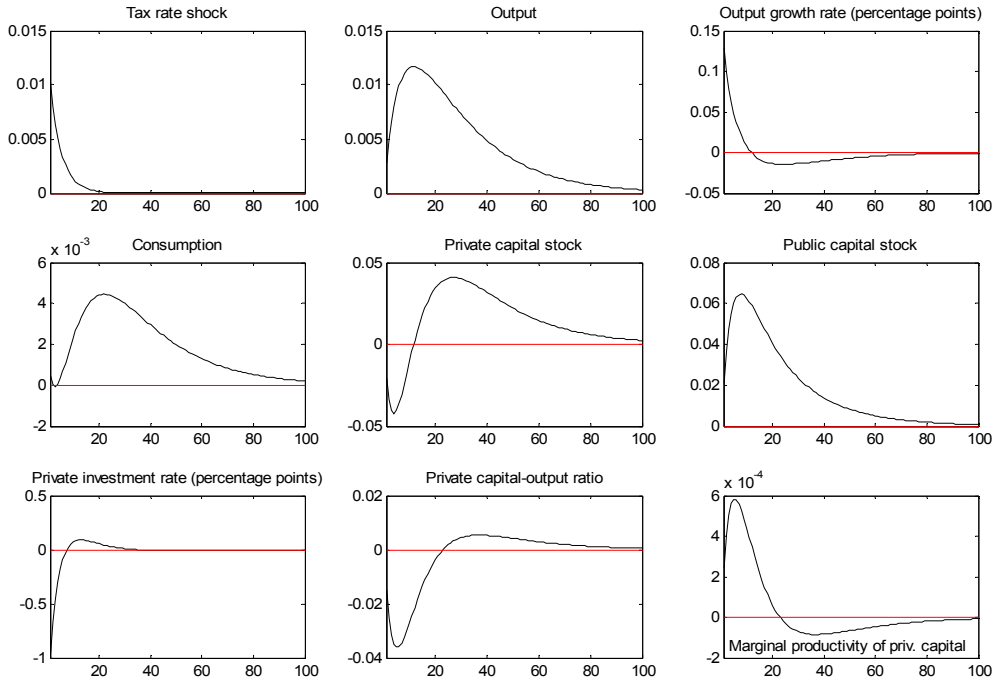


Source: IMF staff estimates.

20. Figure I.8 shows in more detail the effect of an increase in the tax rate (i.e., a temporary increase from 8 percent in the baseline to 9 percent in the simulation). At this low rate, the tax increase has a clear positive impact on the economy. As with grant-financed public investment, output and the marginal productivity of private capital increase on impact. The key difference is that tax financing leads to an initial crowding out of private investment, and, to a much lesser extent, private consumption. Over time, though, the increase in the marginal productivity of private capital leads to a crowding in of private investment, and both private capital stock and consumption rise above their baseline values.

21. The result that tax-financed increases in public investment can be beneficial when the tax rate is initially low, is likely to be relevant to Burkina Faso, because its tax ratio is well below the regional average. In fact, raising the revenue effort is a major objective of the Poverty Reduction and Growth Facility-supported program, partly to create fiscal space for higher public investment, in line with the simulations here, but also to lower external borrowing requirements.

Figure I.8. Response to Tax Rate Shock
(Deviation from baseline; baseline tax rate: 8 percent)

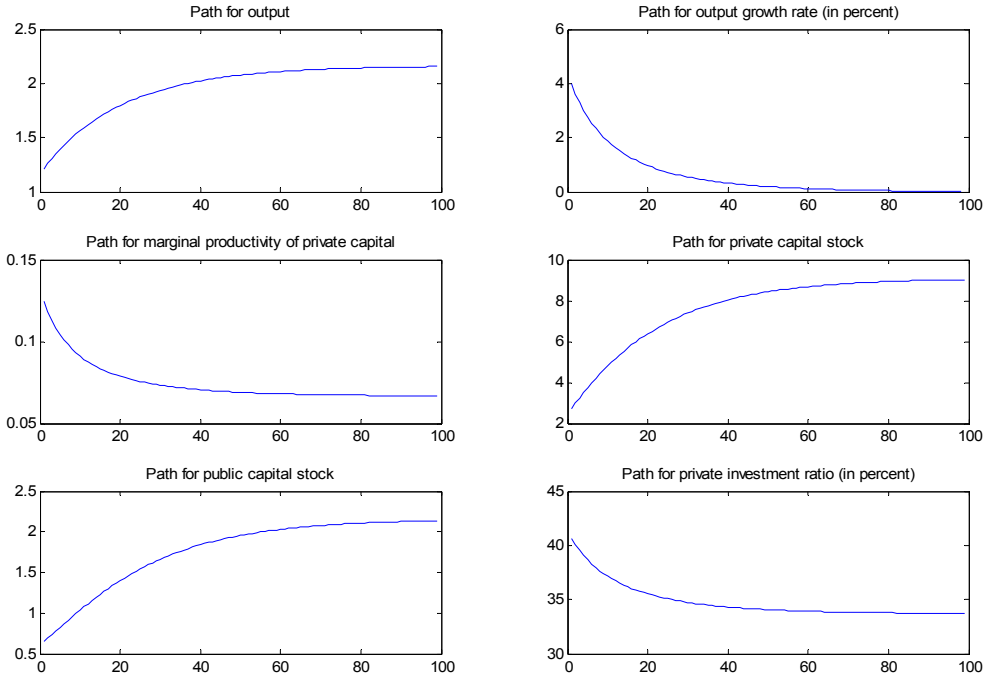


Source: IMF staff estimates.

D. Growth as Convergence to Steady State

22. In contrast to the above steady-state simulations, public investment (and capital accumulation in general) is likely to be very effective in stimulating growth if the economy is initially below its steady state, and short of capital. Figure I.9 simulates the convergence to steady state with output and capital stocks initially about 70 percent below their steady state. Given the low levels of capital, the marginal productivity of private capital is high, which fuels strong private investment; the accumulation of private capital that results causes output to increase rapidly—leading to sustained high output growth rates—and the public capital to build up through tax revenue gains. As the economy nears its steady state, the process of capital accumulation and output growth gradually ebbs. In this situation, increasing public investment would yield sizeable payoffs, because it would hasten the transition to the steady state. Even a temporary increase in public investment would have large, permanent output effects. This contrasts sharply with previous steady-state simulations where temporary increases in public investment have no permanent output effects.

Figure I.9. Convergence to Steady State



Source: IMF staff estimates.

E. Which Growth Process is more Relevant for a Country like Burkina Faso?

23. The above simulations show that, from a theoretical perspective, the key question for judging the role of public investment in growth is the nature of the growth process itself. If growth is characterized by shifts in the steady state (i.e., steady-state growth), the effect of public investment on growth is likely to be limited. But if growth for low-income countries is mostly a process of converging toward a higher-income steady state, public investment can make a large contribution to speeding up the transition toward steady state. Both views of the growth process have plausible real-world narratives.

Steady-state growth and its application to Burkina Faso

24. With steady-state growth, the growth process is driven by productivity shocks. To apply to a country like Burkina Faso, an extensive view of what constitutes productivity shocks needs to be taken (i.e. the underlying productivity concept should encompass a broad array of factors that affect development). For example, private and public sector institutions that govern the degree of economic openness and the quality of governance are likely to be important determinants of the economy's overall productivity level, and so are attainments regarding public health and education. Another aspect may be what Hausmann and Rodrik (2002) term economic "self-discovery", which describes a country's process of learning what goods and services it is good at producing (i.e., allowing it to create a market niche in the international economy).

25. For a given level of productivity, a country can support a certain level of output, capital stock, and consumption, which constitutes its steady state. In the absence of shocks, the country is close to its steady-state level. By this view, Burkina Faso's low-income level would reflect a steady state characterized by, inter alia, weak institutions (consistent with its near-bottom rankings on the World Bank's Doing Business and governance indicators), poor health and education outcomes, and the establishment of only few internationally competitive businesses (consistent with Burkina Faso's low share of exports).

26. Growth occurs through discoveries or improvements that raise the country's productivity level; recent examples of such developments for Burkina Faso would include the discovery of gold deposits that can be commercially mined; improvements to the land title regime, which will help foster financial intermediation; or improvements to the commercial-law judicial system. Past innovations like the introduction of mobile phone networks, broadband internet access, or the rapid expansion in cotton as a profitable export niche, are likely to have long-lasting effect growth effects as economic agents find new ways to exploit the productivity potential of these innovations.

Growth through convergence in the case of Burkina Faso

27. Here, the main factor for Burkina Faso's low income level is the country's small stocks of physical and human capital. Productivity—which is viewed here as a more narrow, technology-oriented concept—is less of a constraint because Burkina Faso is well inside the

world-technology frontier and can draw on a large range of already existing technologies. Capital accumulation should help with the adaptation of new technologies to the extent these are embodied in capital goods. The fact that Burkina Faso is relatively rich in labor but poor in capital implies that returns to capital accumulation should be high and stimulate investment, including foreign investment. From this viewpoint, Burkina Faso's relatively strong growth process over the past 10 years would reflect Burkina Faso's convergence process, starting from a very low base, toward a higher income steady state, resulting in the interim in high growth rates.

Which of the two views is more relevant for Burkina Faso?

28. The view of growth as a convergence process is attractive, because it would suggest a certain inevitability of Burkina Faso's development process and quasi-guaranteed strong growth for many years to come. However, this view has a major disadvantage: there is little cross-country empirical evidence to support it. On the face of it, if low levels of capital stocks are a main driver of growth through the convergence process, one would expect that African countries are among the fastest growing countries in the world, but they clearly are not; Africa dummies in many growth regressions are significant and have a negative sign, which implies they are actually growing slower than suggested by other determinants of growth. Barro and Sala-i-Martin (2004) consider also more formal empirical evidence for the hypothesis of absolute convergence—i.e., that poorer countries tend to grow faster than richer—and find that "this proposition fares badly in terms of the cross-country data: for the 112 countries with the necessary data, the growth rate from 1960 to 2000 is virtually unrelated to the log of per capita GDP in 1960."[17] Empirical evidence points more toward conditional convergence, i.e., once one controls for country characteristics, there is a tendency for countries with similar characteristics to converge to similar income levels.[18]

29. In contrast, steady-state growth does not predict absolute convergence if the likelihood of (broadly defined) productivity gains is independent of a country's income level. If technology diffuses easily among countries with similar characteristics, steady-state growth would be consistent with conditional convergence.

30. There is also a major difference on the role of productivity gains. With growth as a convergence process, the implicit assumption is that productivity gains can be relatively easily achieved through adopting "off-the-shelf"-technology, which is facilitated by capital investments that embody new technologies. However, in a survey of the absorption of

[17] See Barro and Sala-i-Martin (2004), p. 515.

[18] From an empirical viewpoint, the convergence process has another drawback: the high marginal rate of productivity of private capital for countries with low capital stocks would suggest that the real interest rate in these economies is initially high and then declines over the development process, but there is little evidence for substantial changes of the real interest rate through this process. This drawback could be addressed, however, by modifying the theoretical model to include human capital with a fairly large income share, which would dampen the real interest rate movements implied by the model.

foreign technology, Hausmann and Rodrik (2002) find that doing so entails a process of experimentation and learning, and investors may not be able to predict if, when, and how they would become fully competitive, even when the technology is mature elsewhere. In short, they argue that there is no such thing as off-the-shelf technology. If this is the case, productivity gains might be harder to achieve and could become a serious constraint for the convergence growth process: countries that have difficulties in adopting foreign technologies would lack in productivity, which would adversely affect the returns on capital and weaken the incentives for private (and foreign) investment, effectively undermining the convergence process. In contrast, the notion that absorption of foreign technologies is generally difficult is fully consistent with the steady-state growth view; success or failure doing so would be just another factor defining the country's steady state.

31. Overall, the steady-state growth view appears to fit the empirical evidence better than the alternative view of growth as a convergence process. However, steady-state growth should be considered more as a working hypothesis than established fact, because the empirical evidence reviewed here does not make an explicit case for this hypothesis, and other theories not considered here may fit the data as well or better.

F. Empirical Evidence on the Growth Effects of Public Investment

32. Turning to the direct empirical evidence on the growth effects of public investment, there appears to be little consensus. For example, Devarajan et al. (2003) state flatly that public investment is not correlated with growth in Africa. In contrast, a World Bank (2007) survey argues that there is robust evidence that public capital spending has strong growth effects. A recent FAD survey (IMF 2004), on the other hand, finds that existing studies do not give clear-cut results.

33. Part of the reason for the uncertainty about the link between public investment and growth may be that—at least within a neoclassical context—public investment has a strong impact on the output *level*, whereas the effect on the *growth rate* is at best transitory, which standard growth regressions may have difficulties picking up.

34. Another reason may be that the growth effect of public investment depends critically on how it is financed: grant-financed public investment, for example, would be expected to have a larger growth effect than tax-financed public investment. One of the earliest empirical studies to take the importance of the general budget constraint (GBR) into account is Bose et al. (2003), who find that an increase in the public investment-to-GDP ratio has a positive impact on real per capita growth if it is financed by a corresponding reduction in current expenditures or higher tax revenue, but not if it is deficit financed.

35. Table I.1 summarizes the results from a number of recent studies; the notation *GBR* indicates whether the government budget constraint has been taken into account, and the growth impact denotes the effect of a one-time increase in the public investment rate by one percentage point on the long-run output level, which is equivalent to a one-time increase in the output growth rate. Overall, it appears that the long-run output effect is about

0.2 percent (see Figure I.10).[19] This is, in fact, larger than expected from a neoclassical model where the economy is initially in steady state, because in this type of model the long-run effect would be zero. Nevertheless, the point estimates are still relatively small. It should be noted, though, that these results imply a sizeable internal rate of return: a one-time investment of $100 would lead to a future payment stream of $20 each year, which is equal to an internal rate of return of 20 percent.

Text Table I.1: Summary of Studies on the Growth Effect of Public Investment

Study	Growth effect[1]	BGR	Sample characteristics
Khan and Kumar (1997)	1970–90: 0.40 1970–80: 0.21 1980–90: 0.13	No	Sample: 95 developing countries; sample period: varying (see growth effects); time period: decade averages
Aschauer (2000)	Approx. 0.15[2]	No	Sample: 46 LICs and MICs; sample period: 1970–90; time period: change over 1970–90
Devajaran et al. (2003)	Not significant.	No	Sample: 29 African countries; sample period: 1970–97; time period: annual data
Milbourne et al. (2003)	Approx. 0.15[2, 3]	No	Sample: 74 countries; sample period: 1960–85; time period: change over 1960–85.
Bose et al. (2003)	Approx. 0.15	Yes	Sample: 30 developing countries; sample period: 1970–90; time period: decade averages
Clements et al. (2004)	Approx. 0.2	No	Sample: 55 LICs; sample period: 1970–99; time period: 3-year averages
Gupta et al. (2004)	Approx. 0.6	Yes	Sample: 39 ESAF and PRGF countries; sample period: 1990–2000; time period: annual
Adam and Bevan (2005)	0.1[4]	Yes	45 non-OECD countries; sample period: 1970–99; time period: 5-year averages

Source: Referenced research papers.

[1] Effect of a one-time increase in the public investment-to-GDP ratio by one percentage point on the long-run level of output (in percent).

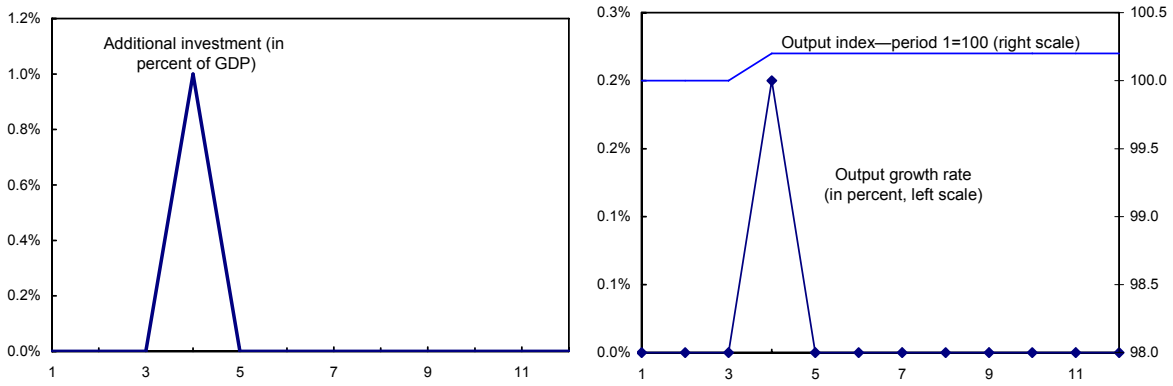
[2] Growth effect for definition used here had to be approximated from empirical results in study.

[3] Estimation produced mixed results, e.g., some aspects of model specification were rejected by data.

[4] Refers to effect of productive expenditures, grant financed.

[19] A noticeable exception is the much higher estimate by Gupta et al. (2004). However, this study uses annual data and has a relatively short sample period, which together could suggest that the estimate is more influenced by short-run effects than the other studies considered here.

Figure I.10. Growth Effect of Public Investment—Summary of Empirical Evidence

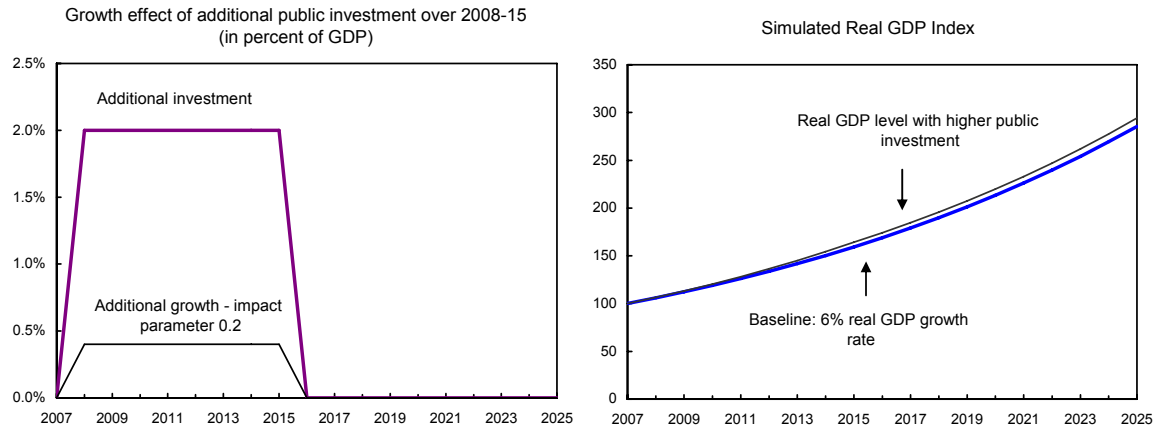


Source: IMF staff estimates.

G. Conclusion and Implications for Burkina Faso

36. The above empirical estimates imply that an increase in the public investment-to-GDP ratio by 2 percentage points in the medium term, as currently projected, would raise the real GDP growth rate by about 0.4 percentage points a year for as long as public investment is held at that rate. Compared with an underlying growth rate of about 6 percent—based on historical averages—the additional investment will have a noticeable but modest impact on future growth and output levels (Figure I.11). Output could be some 10 percentage points of GDP higher by 2025—a respectable number, but not nearly as large as the overall increase in GDP of almost 200 percent by that year based on underlying growth.

Figure I.11: Burkina Faso: Growth Effect of Higher Public Investment



Source: IMF staff estimates.

37. The considerations above suggest that a growth strategy for Burkina Faso should not count on public investment alone. If growth is characterized by steady-state growth, than

continuous improvements across a broad array of development factors are required to sustain it. Consequently, government policies to improve institutions, or risk taking by the private sector to create viable international market niches, would likely be as important, if not more so, than increasing public investment. These policies could contribute to raising productivity in the economy, which is the ultimate source of growth in all economies. Thus, improving Burkina Faso's external and overall competitiveness—the topic of the next chapter—will likely do most do raise growth over time.

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